

Claims

We Claim:

1. A method for producing an improved copolymerized product comprising:  
copolymerizing at least one vinylaromatic monomer with at least one diene  
polymer in the presence of at least one multifunctional initiator  
selected from the group consisting of trifunctional and tetrafunction-  
al peroxides, and  
recovering a copolymerized product that has a ratio of % gel to % rubber  
(G/R) that increases as swell index increases.
2. The method of claim 1 where the copolymerized product has a melt flow  
index (MFI) ranging from about 2 to about 7.
3. The method of claim 1 where the G/R increases from about 1 to about 4 as  
the swell index increases from about 8 to about 20.
4. The method of claim 1 where in copolymerizing the monomer, the  
vinylaromatic monomer is styrene.
5. The method of claim 1 where in copolymerizing the monomer, the  
multifunctional initiator is selected from the group consisting of tri- or tetrakis t-  
alkylperoxycarbonates, tri- or tetrakis (polyether peroxycarbonate), tri- or tetrakis-  
(t-butylperoxycarbonyloxy) methane, tri- or tetrakis-(t-butylperoxycarbonyloxy)  
butane, tri- or tetrakis (t-amylperoxycarbonyloxy) butane and tri- or tetrakis (t-C<sub>4-6</sub>  
alkyl monoperoxycarbonates), and mixtures thereof.
6. The method of claim 1 where the copolymerized product is more highly  
branched as compared with a polymerized product made by an otherwise

identical method except that a multifunctional initiator replaces at least a portion of a difunctional initiator.

7. The method of claim 1 where the multifunctional initiator is present in an amount ranging from about 50 to about 1200 ppm, based on the vinylaromatic monomer.
8. The method of claim 1 where in copolymerizing the monomer, the polymerizing is conducted at a temperature between about 110°C and about 180°C.
9. The method of claim 1 where the weight ratio of vinylaromatic monomer to diene polymer ranges from about 97:3 to about 85:15.
10. The method of claim 1 where in recovering the product, the copolymerized product is high impact polystyrene (HIPS).
11. The method of claim 1 where the polymerization rate ranges from about 2 to 7 times that of styrene polymerized thermally in the absence of initiator.
12. The method of claim 1 where the polydispersity of the copolymerized product ranges from about 2.3 to about 4.0.
13. An improved copolymerized product made by the process comprising:  
copolymerizing at least one vinylaromatic monomer with at least one diene polymer in the presence of at least one multifunctional initiator selected from the group consisting of trifunctional and tetrafunctional peroxides, and  
recovering a copolymerized product that has a ratio of % gel to % rubber (G/R) that increases as swell index increases.

14. The copolymerized product of claim 13 where the copolymerized product has a melt flow index (MFI) ranging from about 2 to about 7.
15. The copolymerized product of claim 13 where the G/R increases from about 1 to about 4 as the swell index increases from about 8 to about 20.
16. The copolymerized product of claim 13 where in copolymerizing the monomer, the vinylaromatic monomer is styrene.
17. The copolymerized product of claim 13 where in copolymerizing the monomer, the multifunctional initiator is selected from the group consisting of tri- or tetrakis t-alkylperoxycarbonates, tri- or tetrakis (polyether peroxycarbonate), tri- or tetrakis-(t-butylperoxycarbonyloxy) methane, tri- or tetrakis-(t-butylperoxycarbonyloxy) butane, tri- or tetrakis (t-amylperoxycarbonyloxy) butane and tri- or tetrakis (t-C<sub>4-6</sub> alkyl monoperoxycarbonates), and mixtures thereof.
18. The copolymerized product of claim 13 where in recovering the copolymerized product, the product is more highly branched as compared with a polymerized product made by an otherwise identical method except that a multifunctional initiator replaces at least a portion of a difunctional initiator.
19. The copolymerized product of claim 13 where in the copolymerizing the multifunctional initiator is present in an amount ranging from about 50 to about 1200 ppm, based on the vinylaromatic monomer.
20. The copolymerized product of claim 13 where in the copolymerizing the polymerization rate ranges from about 2 to 7 times that of styrene polymerized thermally in the absence of initiator.

21. The copolymerized product of claim 13 where the polydispersity of the copolymerized product ranges from about 2.3 to about 4.0.
22. The copolymerized product of claim 13 where in copolymerizing the monomer, the polymerizing is conducted at a temperature between about 110°C and about 180°C.
23. The copolymerized product of claim 13 where in copolymerizing the monomer, the weight ratio of vinylaromatic monomer to diene polymer ranges from about 97:3 to about 85:15.
24. The copolymerized product of claim 13 where in recovering the product, the polymerized product is high impact polystyrene (HIPS).
25. An article made with the vinylaromatic/diene graft copolymer of claim 13.
26. A resin comprising:  
at least one vinylaromatic monomer;  
at least one diene polymer;  
at least one multifunctional initiator selected from the group consisting of trifunctional and tetrafunctional peroxides, where the amount of multifunctional initiator is sufficient to produce a copolymerized product that has a % gel to % rubber (G/R) ratio that increases as swell index increases.
27. The resin of claim 26 where the amount of multifunctional initiator is sufficient to polymerize the vinylaromatic monomer at a rate of from about 2 to 7 times that of styrene polymerized thermally in the absence of initiator.

28. The resin of claim 26 where the amount of multifunctional initiator is sufficient to produce a copolymerized product having a polydispersity ranging from about 2.3 to about 4.0.
29. The resin of claim 26 where the amount of multifunctional initiator is sufficient to produce a copolymerized product that has a melt flow index (MFI) ranging from about 2 to about 7.
30. The resin of claim 26 where the G/R increases from about 1 to about 4 as the swell index of the product made therefrom increases from about 8 to about 20.
31. The resin of claim 26 where the vinylaromatic monomer is styrene.
32. The resin of claim 26 where the multifunctional initiator is selected from the group consisting of tri- or tetrakis t-alkylperoxycarbonates, tri- or tetrakis (polyether peroxycarbonate), tri- or tetrakis-(t-butylperoxycarbonyloxy) methane, tri- or tetrakis-(t-butylperoxycarbonyloxy) butane, tri- or tetrakis (t-amylperoxy-carbonyloxy) butane and tri- or tetrakis (t-C<sub>4-6</sub> alkyl monoperoxycarbonates), and mixtures thereof.
33. The resin of claim 26 where the copolymerized product made therefrom is more highly branched as compared with a polymerized product made by an otherwise identical method except that a multifunctional initiator replaces at least a portion of a difunctional initiator.
34. The resin of claim 26 where in the multifunctional initiator is present in an amount ranging from about 50 to about 1200 ppm, based on the vinylaromatic monomer.

35. The resin of claim 26 where the weight ratio of vinylaromatic monomer to diene polymer ranges from about 97:3 to about 85:15.
36. An article made from the resin of claim 26.